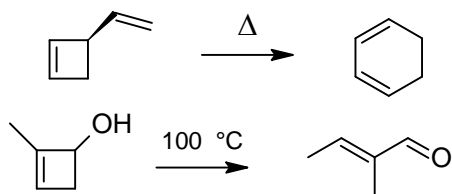
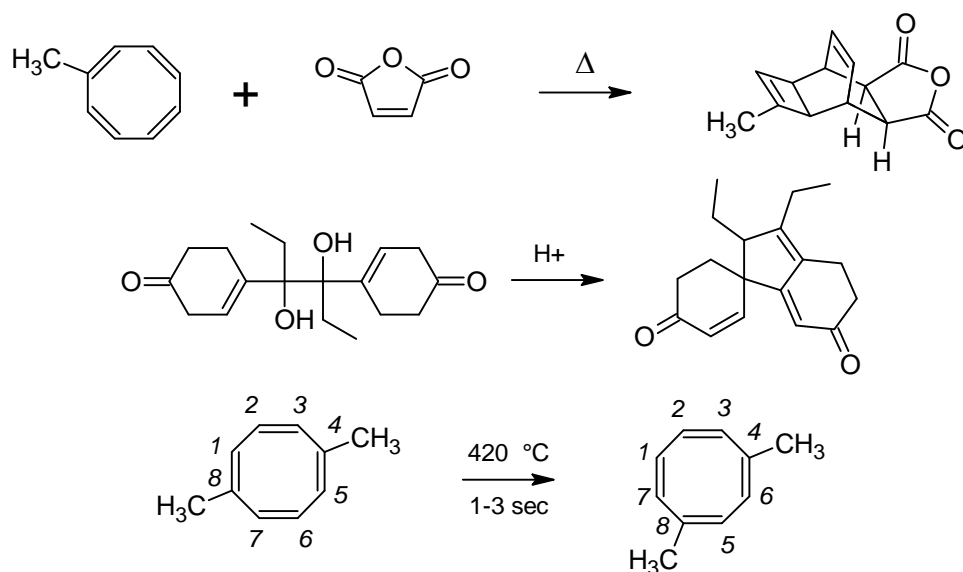


1. **Warm up. Stretch.** (These are provided for practice. You do not have to turn them in.) Draw a step-by-step mechanism for each reaction. As usual, your mechanism should include appropriate labels for pericyclic reactions and stereochemistry where important.

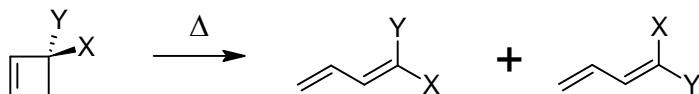


2. **The Work-Out.** Same instructions as #1, but turn these in. (Hint: every one of these involves an electrocyclic step at some point.)



The ring C numbering is consistent with my answer, but I don't know if there is experimental support for it.

3. *Torquoselectivity* refers to the direction of rotation during an electrocyclic reaction. For example, these ring-openings must be *conrotatory*, but two torquoisomers are possible:



Use HF/3-21G transition state models¹ to evaluate torquoselectivity for the case where X=H and Y=CH₃. Compute $\Delta(\Delta E^\ddagger)$ and the expected product ratio at 200 °C. Rationalize your result if you can.

¹ You need models of the two transition states. Search the *Spartan* database for the ring-opening transition state of cyclobutene. Make two copies. Add X & Y in appropriate locations to each. Then perform a transition state search and verify the final geometry is a transition state by calculating its IR spectrum. (Hint: you might need to calculate IR spectrum of the initial model for the transition state search to work.)